PCT/GB 2004 / 0 0 3 0 0 1

The Patent Office

INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

PRIORITY DOCUMENT

SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

REC'D 10 SEP 2004
WIPO PCT

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

I also certify that the attached copy of the request for grant of a Patent (Form 1/77) bears an amendment, effected by this office, following a request by the applicant and agreed to by the Comptroller-General.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed M Cunkie

Dated 19 August 2004

Patents Form 1/77

Patents Act 1977
(Rule 16)

THE PATENT OFFICE
RN
11 JUL 2003
RECEIVED BY FAX

The Patent Office

11JUL03 E821753-1 C07580
P01/7700 0.00-0316192.4

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference

   3DHYDRO/03

2. Patent application number
   (The Patent Office will fill in this part)

   0316192.4 | 11 JUL 2003

3. Full name, address and postcode of the or of each applicant (underline all surnames)

   University of Leeds
   Woodhouse Lane
   Leeds, LS2 9JT

   Patents ADP number (if you know it)

   If the applicant is a corporate body, give the country/state of its incorporation

   ENGLAND

   5916168004

4. Title of the invention

   HYDRO LINK SPACER FABRICS

5. Name of your agent (if you have one)

   "Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

   Harrison Goddard Foote
   31 St. Saviorgate
   York
   YO1 8NQ

   ~~RAYMOND WOLFSON~~
   IPMU
   UNIVERSITY OF LEEDS
   3 CAVENDISH ROAD
   ~~LEEDS, LS2 9JT~~

   Patents ADP number (if you know it) (F5117)

   5916168005

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country	Priority application number (if you know it)	Date of filing (day / month / year)
N/A		

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing (day / month / year)
N/A	

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:
   a) any applicant named in part 3 is not an inventor, or
   b) there is an inventor who is not named as an applicant, or
   c) any named applicant is a corporate body.
   See note (d))

   YES

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	NONE
Description	THREE
Claim(s)	NONE
Abstract	NONE
Drawing(s)	ONE

10. If you are also filing any of the following, state how many against each item.

Priority documents	NONE
Translations of priority documents	NONE
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	NONE
Request for preliminary examination and search *(Patents Form 9/77)*	NONE
Request for substantive examination *(Patents Form 10/77)*	NONE
Any other documents *(please specify)*	NONE drawing included in description

11. I/We request the grant of a patent on the basis of this application.

Signature R Wolfson Date 11/07/03

12. Name and daytime telephone number of person to contact in the United Kingdom RAYMOND WOLFSON 0113 343 7261

Warning
After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes
a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.*
b) *Write your answers in capital letters using black ink or you may type them.*
c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*
d) *If you have answered 'Yes' Patents Form 7/77 will need to be filed.*
e) *Once you have filled in the form you must remember to sign and date it.*
f) *For details of the fee and ways to pay please contact the Patent Office.*

Hydro Link Spacer Fabrics

June 2001 NRG, University of Leeds

Background

The formation of nonwoven materials with a three-dimensional structure has been reported previously (USP5674591:1994, EP0692564:1996, EP0605015:1992, USP0447090:1990, USP5165979:1990, USP5066538:1991, EP0977914:2000).

Le Roy described a method (USP 5475904, which is known commercially as the NAPCO system) for producing 3D structures by joining two or three fibrous materials together with a space left between the basic layers. The layers of fibrous materials can be woven, knitted, nonwoven or a combination of these. Barbed needles operating between two stripper plates transfer fibres from one layer to another to form links or bridges between separate layers. Alternatively, it is claimed that joining the layers can be achieved by stitching or ultrasonic welding. The two layers are kept a predetermined distance apart by a spacer plate. The spacer plate and stripper plates are adjustable by hand wheels and allow structures ranging in thickness from 5 to 50 mm to be made. Filling materials can be introduced between the two basic layers, which may be resin, powder, fibres, tubes, wire, threads, and/or electrical conductors. It is claimed that various different structures can be more economically formed using this approach compared to conventional methods. The 3D materials produced can be used in drainage, reinforcement, and insulation applications.

The use of needlepunching to interconnect layers as described by Le Roy (USP5475904) limits the speed of production to a maximum of about 10m/min (USP5475904) and generally there are limitations in simultaneously bonding and connecting layers in lightweight fabrics below 100 g/m^2. In this way, a preconsolidated web structure is normally required which tends to increase the cost of production. A further limitation of the existing method is the possibility of needle breakage, which has a deleterious effect on fabric quality and product acceptance in critical applications (e.g. contact layers used in woundcare).

We have unexpectedly discovered a method of overcoming these problems using an alternative approach that relies on the use of fluid jets to interconnect fibres through a spacer system.

Summary of the Invention

The new approach involves the use of fine columnar water jets (of ca. 80 - 200 micron diameter) and a spacer system to either:

1) Simultaneously bond and inter-connect separate layers of web to produce an integrated 3D structure with engineered internal architectures.
2) Interconnect fibres in a pre-bonded structure to achieve similar architectures.

In the new approach webs (containing textile fibres) formed by carding, carding and lapping, air-laid, melt-blowing or spunlaid methods are introduced either side of a spacer device which keeps the webs apart. A basic diagram of the approach is shown

in Figure 1. By way of example only and not exclusively, the following method can be used. The lower web is supported on a porous conveyor, which acts as a conveyor belt. Under this belt a suction system is provided to remove excess water. The lower web is carried on the conveyor until it is immediately below the spacer system (or the spacer system is placed on top of the lower web). The upper web is then introduced on top of the spacer system. The webs and spacer system are passed under one or more hydroentanglement injectors (after an optional prewetting stage) in which fibres in one web are transferred between the gaps in the spacer system towards the adjacent web. During this process some fibres are also entangled thereby increasing the structural integrity of the web. Following this, hydroentanglement is applied from the reverse side in the same way. Fibres from the two webs interconnect to form an integrated structure. The energy applied influences the structure of the interconnections particularly the number of transferred fibres. This process may be repeated multiple times depending on requirements. Then, the fabric is slid off the spacer system and is dried and collected.

Referring to Fig. 1 water jets are impinged on the webs to simultaneously entangle and consolidate fibres in both layers as well as interconnect adjacent layers. The shape and morphology of the spacer device, which may be repeated across the operating width of the fabric or may be varied as required, influence the internal structure of the resulting fabric. In a simple embodiment, the spacer device may be an array of smooth rods of different sizes or cross-sections. If the rods or spacer elements are hollow components such as wires, fluids, powders resins, yarns, etc. can be inserted in to the fabric by passing the external component through the spacer elements or tubes. In this way composite products can be readily produced.

After the basic fabric has been formed, secondary bonding may be used to stabilise / modify the structure. Preferably, but not exclusively thermal bonding is used which preferably involves either convection heating of the fabric using an oven system or radiant methods.

In comparison to other methods of forming nonwoven and composite nonwoven structures the proposed approach offers more flexibility in terms of raw materials, production speed and fabric structure variations.

Two webs are positioned either side of a spacer device which in this example consists of uniformly spaced cylindrical tubes. The lower web is supported on a porous conveyor. High pressure water jets are impinged on the web (preferably from both sides). In double sided-treatments each side is conveniently treated in separate stages. Using the water jets, fibres are transferred from each web in to the interspace between the spacer bars where they become inter-connected and form an integrated 3D structure. The water jet energy introduced on each side can be varied to modify the structure as required. Two or more webs can be introduced on both sides (as required). After the required energy has been introduced the structure can be slid off the spacer system leaving a 3D structure having internal voids or pores, the shape and dimensions of which are a function of the spacer system design. To improve the stability of the structure secondary bonding may be used. Preferably, through-air bonding (convection) methods are used (assuming at least a proportion of the fibres are thermoplastic) although radiant methods can also be applied. Additionally, other

components can be introduced in to the cross-section of the fabric by introducing such materials in to the centre of the spacer elements (assuming they are hollow). This provides a simple and convenient method of producing composite structures containing resins, filaments, yarns, solutions, cable, pharmaceuticals, powders, etc.

<u>Figure 1 Schematic of Formation System a) End-on cross-sectional view b) Side view c) Final structure</u>